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A study of the balance between petroleum supply and demand in the Western Hemisphere.

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A STUDY OF THE BALANCE BETWEEN PETROLEUM SUPPLY AND DEMAND IN THE WESTERN HEMISPHERE

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A STUDY OF THE BALANCE BETWEEN PETROLEUM SUPPLY AND DEMAND IN THE WESTERN HEMISPHERE

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I

PURPOSE

As modern industrial civilization becomes increasingly dependent on petroleum and the products derived therefrom, and as victory in global war comes to depend more and more on superior command over petroleum supplies, the study of petroleum supply and demand assumes an increasing importance.

The author plans in this thesis to make a brief survey of the petroleum supply and demand in the Western Hemisphere and of latest trends and developments. The express purpose of the study is to examine the factors influencing petroleum supply and demand within the Hemisphere and to assess the prospects for maintaining a favorable balance of supply during the next few years.

II

IMPORTANCE OF THE SUBJECT
OPINIONS REGARDING FUTURE PETROLEUM SOURCES IN THE UNITED STATES
RECENT DEVELOPMENTS AND TRENDS
GENERAL INTRODUCTORY COMMENT
REMARKS

In a "Report of Investigation of Petroleum in Relation to National Defense - 1947" the Honorable Dewey Short, in speaking of the petroleum future of the United States, concluded that "It may take about ninety years to find our remaining undiscovered oil, with probably some two thirds of it found in the first half of the period or within forty five years." This statement, if reasonably true, is noted by Eugene Ayres in his recent book, "Energy Sources - The Wealth of the World", to infer a production of not more than one billion barrels a year for the United States approximately some twenty years from now. This amount of production, moreover, equals less than one half of the current United States annual requirement and would undoubtedly be equivalent to a considerably smaller percentage of total United States requirements at that future time. Even more important, however, is the fact that the basic assumption implies an attainment of peak production of crude oil in the United States sometime between the years 1955 and 1960, with only the unlikely possibilities of either a reduction in current rate of demand or of a major policy change, which would permit a substantial increase in the rate of oil importation into the United States, as the factors which could postpone this date of peak production. Gradual decline in United States production must inevitably follow this peak.

Important to any overall consideration of future United States petroleum supplies is the current and widely held opinion that unless an unlikely amount of political pressure is applied it must be assumed (for planning purposes at least) that large scale conversion of coal to oil will not be undertaken in the United States until such time as petroleum from domestic sources plus adjacent foreign supplies (i.e. Venezuela and Canada) can no longer meet United States demand. In addition, many authorities believe that economic considerations will postpone oil shale development on any major scale in the United States until some time after the processing of coal has been undertaken. One line of reasoning for the unlikelihood of early large scale oil shale development is that mining of oil shale in Scotland (the only pioneer country where shale mining has not been discontinued) has shown that little incentive for research and development exists in a subsidized industry in which the profits are nominal and fixed by government.[1] Other adverse factors are difficulties of mining, objectionable odor, impurities, and the fact that United States shale deposits occur in relatively inaccessible and arid regions. One additional supplementary domestic source of supply of liquid fuel which is now being utilized to a limited extent, is the conversion of natural gas. However, recent nationwide expansion in the regular use of natural gas plus sound economic considerations would seem to make any large scale development of gas as a source of liquid fuel highly improbable. It is evident in general that a principal obstacle to the use of any alternate source of supply for

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[1] "Energy Sources - The Wealth of the World", Ayres and Scarlot

liquid fuel in the United States lies in the very real economic advantages which accure from using the cheapest fuel available. Increasing United States imports from Western Hemisphere sources must for this reason be conceded to be highly probable.

The issue of conserving Western Hemisphere and especially United States oil resources for a possible emergency still remains an unsettled one. The political and economic ramifications of a national conservation-control policy are many and of such great magnitude and the wisdom and feasibility thereof so questionable as to make any early measures in this direction rather unlikely. A private report by Wallace Pratt to the National Security Resources Board, which report has not been published, "is said to recommend cutting U. S. domestic production 20 per cent under maximum efficient rate and importing the difference. Such a program it is argued by its proponents would provide a breathing spell which would allow the U. S. domestic industry to build up its crude reserves to a safer level from the standpoint of National Defense."[1] Although the details have not been disclosed, a program of this nature would seem inevitably to require some form of government subsidy and to pose great difficulties of transition and administration, besides being of questionable overall wisdom. Evidence of some recent industry thinking possibly in this direction, however, is contained in The Standard Oil Company of California's 1951 Report to Stockholders which notes that, "The United States, the world's largest producer of petroleum products, draws disproportionately upon its domestic oil reserves as compared with production from the world's total reserves."

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[1] "Arabian Oil - America's Stake in the Middle East", Mikesell and Chenery

A recent report by the National Petroleum Council, entitled "Petroleum Productive Capacity 1952", contains the latest comprehensive investigation of present and probable future petroleum productive capacity and availability in the United States and throughout the rest of the world as interpreted by leading members of the United States oil industry. Its conclusions are broadly optimistic and because of the authoritative character of the report they must be accorded considerable respect. The question as to whether the world can go on consuming petroleum at the present expanding rate without bringing world reserves dangerously low is very carefully examined. (World production in 1951, for example, was 4.5 billion barrels and is likely to be double that within 15 years). The answer by the Council is a qualified affirmative one.

While the fact that proved reserves have kept pace with expanding production is certainly indisputable it would hardly seem, to the writer, that this in itself provides full and complete justification for assuming that they will continue to do so.[1] In the report, careful calculated estimates, based on detailed geological estimates, are given by the National Petroleum Council to support their conclusion that in all probability there is enough oil in the ground to meet the world's needs for the foreseeable future and accordingly any decline in availability will not be because there are insufficient petroleum deposits left. However, as noted succinctly by the "Petroleum Times", issue of May 30, 1952, "Other factors could produce such a decline. Oil in the ground is not the same thing as oil in supply lines. It may become increasingly difficult and expensive to exploit it."

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[1] This doubt is expressed primarily because world reserves are a finite quantity and secondly because of the fact that the portion of undiscovered reserves held in stratigraphic type traps will in all likelihood prove more difficult of discovery than the structurally held oil.

However, the Council appears confident in the Report that technological problems will not prove insuperable. Only two possibilities are mentioned as likely to affect continuing expansion in the use of petroleum, namely, growing competition from new alternate sources of power such as atomic energy or solar energy, and secondly, but far more important, the possible failure of economic incentive or of equipment supply. A great deal of emphasis is placed by the Report on the importance of a favorable economic climate if future oil supplies are to keep pace with expanding need. This single factor undoubtedly holds a major key to the future adequacy or inadequacy of world oil supply and especially to the future development of supply in the Western Hemisphere.

Petroleum exploration during 1951 is reported to have reached the highest level worldwide since World War II and as a result total proven crude reserves have now passed the one hundred billion barrel mark for the first time in history. At the beginning of 1952 total world reserves stood at 100,477,560,000 barrels, representing a gain of more than 6 billion barrels over the previous year or an increase of 6.6 percent. World crude oil production for the same period is reported likewise to have surpassed all previous records with 1951 output reaching 4,507,045,000 barrels.[1] This production reflects a rise of some 450,660,000 barrels over the previous record year (1950) or an increase of about 10 percent. It is to be noted that the 1951 increase in world production exceeded the 1951 world reserve increase percentagewise.

Evidence of the rapidly increasing importance of crude oil as a world commodity is gained from recent figures of the worldwide shipbuilding

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[1] "World Oil," February 1952 Issue

program now underway in which a record number of tankers are being built. According to the American Bureau of Shipping there were under construction or on order as of January 1952 in the principal shipbuilding countries outside Russia some 641 tankers totalling 8,094,415 gross tons. This, moreover, is twice the gross tonnage which was under construction in January 1951, namely, 4,017,149 gross tons or 357 tankers. In both periods tanker tonnage exceeded that of all other vessels by a wide margin.

Some indication of the growing importance of petroleum as a world commodity is gained also from the 1951 financial report of the Standard Oil Company of New Jersey. This company earned more in 1951 than any other corporation in the world, $528,460,799. Of this amount, companies outside the United States accounted for approximately $320,000,000, or about 60 percent of total consolidated net income.

That oil is today intimately tied up with all major considerations of national defense is well known. Secretary of Defense Forrestal in 1948 publicly acknowledged before an open hearing of the Armed Services Committee of Congress that in the event of war we must have at least 2,000,000 barrels a day more production than the United States was then capable of producing.

Today constantly expanding operations in all branches of the oil industry attest to an increasing and vital worldwide significance for petroleum comparable only to its military significance. Further, the United States petroleum industry holds undisputed world leadership in these operations, the most pertinent and dynamic aspects of which stem largely from basic economic law, namely that world supply and demand are not static and accordingly not in perfect equilibrium. Only by the study of current economic

trends, moreover, do further changes in world markets and probable future industry requirements become apparent. In addition, a controlled defense type economy is now evolving in the United States. In this type of economy it seems highly likely that the geographic location of further additions to and changes in world reserves will be influenced to an increasing extent by military considerations derived in large part from the study of trends and developments, especially those in the Western Hemisphere. It seems certain, in any event, that these trends together with overall United States emergency requirements viewed in the broader light of world supply and the needs of our actual and potential allies will have great importance.

That the study of current trends in supply and demand has not received nor required in the past the attention it is likely to receive in the future is largely a result of the temporarily restricted development in world petroleum economy stemming out of stringency of supply during the war years. This development should now proceed at an accelerated pace. Secondly, the unstable political and economic conditions which existed in many countries following World War II have now in large measure been eliminated through the "Marshall Plan", The Defense Alliance of NATO (North Atlantic Treaty Organization), and by various treaties.

Certainly, it is only with full recognition of all factors in the worldwide petroleum picture that strategic deftnse planning as well as industry planning can now proceed. This planning is obviously complicated by factors of growing economic nationalism, the continuing scarcity of dollars in international markets, and by an increasing requirement for location of expensive refineries in many foreign areas where economic considerations alone no longer rule. This situation, which will undoubtedly

continue, is only one very good reason for the establishment of the Petroleum Administration for Defense, the United States Government Organization, which is charged with mobilization responsibility for petroleum and with helping the nations of the Western World obtain adequate petroleum supplies. However, it is certainly the very considerable postwar rise in the demand curve for petroleum products which has occurred in the United States, portending as it does a probable growing dependence on foreign oil, which today must constitute the one major factor in all industry and mobilization planning. This planning must now give considerable attention to NATO countries and to Western Hemisphere military and civilian needs as well.

This thesis is based upon a general statistics study of the petroleum picture in the Western Hemisphere and upon considerable reading of the industry and business literature, especially that pertaining to the question of future supply and to basic financial aspects. The subject was selected, first, because it is obviously impossible to comprehend fully the petroleum situation in the United States without taking into account the rest of the hemisphere and, secondly, because of its vital importance from a military viewpoint. In 1951, 27 percent of all crude oil produced in the Western Hemisphere was produced outside the United States and 17 percent of the total demand for petroleum in the hemisphere was other than United States demand. The United States is bound by treaties and economics to the nations of the Western Hemisphere and in the present state of economic development of these countries it is to our interest as well as theirs that an adequate oil supply be available to them.

This introduction has been intended to provide a background of some important aspects and considerations and to note the magnitude and complexity

of future planning, as well as to show future trends. World oil demand continues to rise at an astonishing rate and even a cursory examination of the world political scene will point up the military significance of a petroleum supply within the Western Hemisphere capable of meeting Western Hemisphere demands.

As regards future Western Hemisphere supplies, the late Secretary of Interior, Harold L. Ickes, speaking in 1944 said, "In the future undoubtedly exploration with the drill will extend down the great geological basin which stretches from Eastern Venezuela along the east flank of the Andes through Colombia, Ecuador, Peru, and Bolivia, and it is from these sources that large quantities of oil will be derived for the Western Hemisphere. Prospects are also good for future discoveries in Mexico, parts of Argentina, and the island of Trinidad."[1] Secretary Ickes predictions can be backed up of course with a great deal of favorable geological evidence and also by discoveries which have been made since then. In the same article, however, it might be noted, the Secretary also mentioned that Canada "has a relatively small amount of oil." This statement fortunately is being proved quite wrong.

It is recognised that many facts can be looked at from different points of view. Also that the petroleum picture in the Western Hemisphere cannot be entirely disassociated from the world picture. However, today military considerations are undeniably taking the place of pure economy to an increasing extent. Accordingly, the premise that Middle East Oil will supply Europe's needs in the immediate future thus indirectly conserving Western Hemisphere reserves has been assumed. All statistics appearing

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[1] "We're Running out of Oil," <u>American Magazine</u>, January 1944

in the study which are not otherwise identified have been obtained from one or more of the following unrestricted sources: Petroleum Administration for Defense publications, statements of officials of the Petroleum Administration for Defense, various newspaper releases by the Petroleum Administration for Defense, and lastly from the two publications, "Petroleum Productive Capacity 1952", A Report of the National Security Council, and "Petroleum Facts and Figures 1950", a publication of the American Petroleum Institute.

The main part of the thesis consists of a general discussion of the entire hemisphere followed by coverage of the five most important Western Hemisphere producing countries, exclusive of the United States. Other South American countries are then discussed together and finally conclusions reached are set forth. Effort has been made to present a clear and comprehensive although admittedly brief picture with discussion confined to what seem the more important points. However, since much selection, extrapolation, and elimination are involved in the study and presentation of any subject, it is undoubtedly true that this in itself is a factor tending to influence the reader. For this reason significant statistical data for Canada, Venezuela, Mexico, and Colombia have been preserved in appendices together with some other recent data deemed pertinent to the study. This will assist the reader to make his own further study or interpretation of any portion of these data as desired. Retention of the statistics, it was felt, would permit ready reference and further augmentation or marshalling of facts at a later date, and serve as an aid in arriving at more comprehensive, detailed, and undoubtedly more correct views. Statistics by themselves, however, lack meaning. It is only when considered in the uncertain light of the

times, economically, politically, and socially speaking, that they gain their true significance. Neglect of these factors has invalidated many past assumptions and predictions statistically derived.

In general it can be said that petroleum statistics for many Central and South American countries are not complete. In some countries the government does not permit their release and companies operating in these countries are reluctant for obvious reasons to provide information. Fortunately, the importance of these countries to the overall Western Hemisphere picture is not great at the present time. All statistics which have been used are considered to be authoritative and to provide the best overall measure of developments. No access to classified information of any sort has been had in the preparation of this thesis. Views expressed are those of the writer and should in no way be construed as "official" views.

III

GENERAL STATISTICS

The astronomical growth in demand for petroleum products which has occurred in the United States is well illustrated by the following data obtained from American Petroleum Institute sources:

(In thousands of barrels per day)	1941	1945	1951
Total demand	4,369	5,358	7,453
Total supply	4,339	5,321	7,556
Included in demand and supply totals			
Exports (demand)	298	500	357
Imports (supply)	266	311	903
Net imports	(-) 32	(-) 189	546

In the above table, if imports are subtracted from supply and exports from demand, the 1951 balance for the continental United States becomes - Supply 6,653,000 barrels per day - Demand 7,096,000 barrels per day. Our shut in crude oil productive capacity (about 10 percent) is capable of filling this deficit. The pipeline space to move this additional crude to refineries and the availability of refinery capacity in the right locations are questions, however, not so easy to answer, the principal factors being of course steel supply and time. The main purpose here, however, is to show that the United States is today a net importing nation and has been since 1948. According to the United States Bureau of

Mines, United States crude production in 1950 amounted to 1,973,574,000 barrels and reached 2,244,529,000 barrels in 1951. Moreover, United States net imports of crude and refined products, taken together, decreased in 1951. Imports in 1951 exceeded exports by 153,193,000 barrels as compared with an excess of 198,114,000 barrels (imports over exports) in 1950. These latter statistics are encouraging at least in showing that United States dependence on foreign sources does not appear likely to become major within the immediate future, or likely to get out of hand with respect to tanker availability.

Other encouraging signs in the Western Hemisphere during 1951 were new discoveries in the Williston and Uinta Basins, and also in Texas, the extensions to known fields in Venezuela, where some 190 new producing wells were completed, the opening up of a new area in Colombia, and an impressive increase in the total number of producing wells in Canada from 844 to 1,140. Moreover, the current production situation in the Western Hemisphere, exclusive of the United States, has been recently summed up by a Petroleum Administration for Defense official (W. H. Farrand) in a Petroleum Administration for Defense news release of 23 June 1952 to be as indicated on the following page.

Current Crude Production - B/D		Outlook - According to W. H. Farrand
Canada	225,000 to 300,000	A high discovery rate for years.
Venezuela	1,800,000	Can reach 2,000,000 B/D.
Mexico	227,000	More production only from new discoveries.
Colombia	105,000	Probably has some more oil to be found.
Peru	43,000	Some companies may drill for more oil.
Argentina	68,000	Small prospects and holds monopoly on oil exploration.
Trinidad	56,000	No forecast possible.
Brazil	2,000	Could become important producer, but oil is a government monopoly.
Cuba	300	Test wells being drilled that may tell future.
Br. Honduras	Little or none	Has oil seepages; wells have found no oil.
El Salvador	Little or none	Poor.
Honduras	Little or none	Poor.
Guatemala	Little or none	Poor.
Costa Rica	Little or none	Oil and gas seepages; wells have found no oil.
Panama	Little or none	Test wells have found no oil.
Ecuador	7,200	Not too bright.
Bolivia	1,500	There is oil to be found.
Chile	1,500	Unfavorable, and drilling under government.
Uruguay	Little or none	Unencouraging.
Paraguay	Little or none	Recent tries for oil failed.

Crude oil reserves in thousands of barrels as of 1 January 1951 and the ratio of reserves to current production were as indicated for principal producing countries of the Western Hemisphere:

		Ratio	South America		Ratio
Canada	1600	32.6	Colombia	450	11.6
Mexico	1400	18.3	Venezuela	10000	16.1
United States	26121	11.6	Chile	35	40.0
Total North America	29125	12.3	Brazil (potentiality)		
			Argentina	340	13.5

The above ratios contrast rather sharply with the ratio for world reserves, the present 102,320,000,000 barrels of world reserves being equivalent to an overall or worldwide ratio (reserves to current production) of 24.0.

It is intended to concentrate this study statistics wise on countries of the Western Hemisphere exclusive of the United States, and

therefore the mention of only the following additional United States statistics will be made. As of 31 December 1951 average crude oil capacity of United States refineries amounted to 7,482,000 barrels per day and the Petroleum Administration for Defense estimate of United States domestic availability of crude and natural gas liquids (based on estimated maximum efficient rates and excluding the United States Naval Petroleum Reserve No. 1) stood at 7,692,000 barrels daily. A further and very pertinent factor in relation to the United States petroleum picture is that during the first 70 years of United States production we added 0.7 barrel to our reserves for each barrel of oil produced and an average of 0.6 barrel has been added to United States reserves for every barrel produced during more recent years. The dynamic aspects of a free competitive economy are nowhere better illustrated than by these two significant figures. Certainly, they provide primary justification for continuation of reasonable economic incentives to an industry in which risks involved in the discovery of new supplies, and the total investment capital required are both very great.

As of January 1951 the productive capacity of Canada and the other countries of the Western Hemisphere less the United States in thous. barrels per day is given to be as follows:

	Productive Capacity			Production			Reserve Productive Capacity	
	Crude	Nat.Gas Liquids	All	Crude	Nat.Gas Liquids	All	Crude Oil	All Oils
Canada	165	2	167	95	2	97	70	70
Latin America	2130	22	2152	2126	22	2148	4	4
Total	2295	24	2319	2221	24	2245	74	74

The trend of Western Hemisphere production and Western Hemisphere demand in thousands of barrels daily excluding the United States is as shown below:

Year	Production	Demand	Balance
1938	859	488	371
1946	1446	826	620
1947	1606	933	673
1948	1779	1049	730
1949	1815	1093	722
1950	2056	1237	819

The maintenance of a favorable Hemisphere balance, although small when United States import requirements are subtracted, is certainly an encouraging sign. However, in the years ahead it appears very likely that United States requirements will absorb the major share of this surplus. United States net imports for 1951, for example, reached 546 thousand barrels daily and despite the fact, already noted, that there was a decrease for 1951 in net imports from the high of 1950, operation of basic economic factors would seem to make this reversal of trend merely temporary at best. In fact there is always the possibility that the whole Western Hemisphere may become a net importer of oil, (although likely only temporarily). One ever present reason for such a possibility is not difficult to understand. B. T. Brooks, an American petroleum chemist, has made a tentative productive decline estimate for all United States fields as of the recent war years. In his book, "Peace, Plenty and Petroleum", he states that in the United States the declining rate of productibility for each one billion barrels of

current production at that time and in the absence of new discoveries or developments could be assumed for planning purposes to be of the magnitude of about 100 million barrels each year for the first two years, then at 75 million barrels for each of the next two years and finally at 50 million barrels per year for the following eight years. In other words it is vital that new sources of production be constantly developed if a production margin is to be maintained in the face of expanding demand. If new discoveries were to cease entirely supply drops rather quickly to about half the initial figure and then continues to decline more slowly for many years. Moreover, such a decline rate can be assumed for production throughout the Western Hemisphere. Exhaustion, however, is an absolute never reached since even the older fields will continue to produce a little oil for many years. All of which means that the rate at which oil can be produced is fundamentally dependent upon the finding of new fields.

The above explanation provides the reason that, beginning 1 July of this year, the Petroleum Administration for Defense Program very significantly calls for drilling by 31 December 1953 approximately 80,000 wells in the United States and 10,128 in foreign areas. In the foreign areas the 10,128 wells will include 4020 to be drilled in Canada and 6108 in other foreign areas. Of the latter figure 5250 are to be development wells with 82 percent of these in the Western Hemisphere; and 858 will be exploratory wells with 69 percent located in the Western Hemisphere. This impressive foreign drilling program is expected to increase producibility by a <u>net</u> of 867,000 barrels daily by the end of 1953. Presumably the assumption can be made conservatively that approximately 60 percent or about 500,000 barrels daily of this net increase is to be obtained in the Western Hemisphere.

However, the vital importance of steel to this picture further suggests that as a result of the United States Steel strike the gains from this program may well be less than anticipated. The increase in production as predicted by the National Petroleum Council for the Western Hemisphere by the end of 1953 is, for example, considered to lie within the range of 268,000 to 466,000 barrels daily. A mean of the National Petroleum Council figures would seem therefore a more likely prediction.

Comparative data as to cumulative production, proved reserves, and estimated ultimate total production for the Western Hemisphere from figures by L. G. Weeks as published in 1948 and as modified by C. F. Moulton in 1950, in billions of barrels are quoted below:

	Cum.	Proved	Est. Ultimate
United States	38.9	24.7	110.0
Balance N. A.	2.6	3.0	40.0
Total N. A.	41.5	27.7	150.0
Venezuela	5.0	9.5	80.0
Balance S. A.	1.7	1.0	--
Total S. A.	6.7	10.5	80.0

IV

IMPORTANT PETROLEUM PRODUCING AREAS IN THE WESTERN HEMISPHERE OUTSIDE THE UNITED STATES

A. Canada*

Production of oil in Canada dates back to 1860 when the commercial production of oil in the province of Ontario first began, and although drilling has not occurred at a high rate in eastern Canada in recent years, there are now 18,000 wells in that region. Canadian Parliament member, C. E. Nickle, recently announced, moreover, that millions of dollars will be poured into a search for natural gas and oil in the maritime province of Nova Scotia during the next few years. Other recent announcements have included the intent to search for oil on Anticosti Island in the Gulf of St. Lawrence and at St. Paul's Inlet on Newfoundland's West Coast.

It is, however, Western Canada which is now claiming chief attention with an industrial and commercial stimulation heretofore lacking in this part of Canada. This area was opened to oil production in 1936 with the Turner Valley discovery but it was not until 1947 when LeDuc was brought in that drilling activity on a large scale began. The following year the Red Water and Woodbend Fields were added and the present boom commenced. Western Canada is now one of the most active oil exploration areas in the world. At end of 1949 more than one hundred Canadian and United States companies were doing active exploration work in provinces of Alberta, Saskatchewan, and Manitoba, and a total of 105 geophysical parties were working in these areas.

* See Appendix I

Of 238 exploratory wells drilled in 1950, a total of 44 became successful oil wells, 18 were gas wells and there was 1 gas distillate producer, for a success ratio of 26.5%. Moreover, the relative shallow depth to producing horizons means cheap drilling costs, an extremely important development factor. The Canadian government, which controls some 90 percent of the subsurface land rights, leases tracts for 21-year terms at a $1 per acre rental fee. Moreover, there is currently no capital gains tax to restrict development.

Canada at present requires about 375,000 barrels of crude per day to be self sufficient. Daily crude production as of June 1952, according to the Petroleum Administration for Defense, is estimated at from 225,000 to 300,000 barrels and Canada's potential is likely very close to 100 percent of requirements at the present time. However, transportation for Prairie Province Oil is currently the limiting factor in production. As a result of the high cost of rail transportation one pipeline 1,127 miles long has already been completed from Edmonton, Alberta to Superior, Wisconsin. Lake tankers carry the crude from Superior to refineries at Sarnia and Toronto, Ontario. These refineries are capable of using 70,000 barrels of this crude a day with expansion in capacity planned. A second pipeline to carry oil to the West Coast is now under construction and lines to carry natural gas to British Colombia and to the Northwest section of the United States are also planned. The Trans Mountain Oil Pipeline being driven through the Rocky Mountains will carry Alberta oil to the Pacific Coast. The line, about 700 miles in length, will be finished in 1954 and is to have a capacity of 200,000 barrels a day. Probably a considerable portion of this West Coast delivered crude will eventually find its way via water transhipment

to California refineries. Other pipeline construction recently announced includes a line to be built by Canadian Gulf Pipeline Company, a subsidiary of the United States Gulf Oil Company. This line will run from the Fenn, Big Valley, and Stettler Oil Fields to Edmonton, Alberta. Initial capacity will be 35,000 barrels a day.

Since 1947 oil reserves estimated at almost a billion barrels have been proved in Western Canada. In 1951 a record 108 new discoveries were made - 40 new oil fields and 68 new gas fields - and there were many important extensions of previously discovered areas. Today, Western Canada with some 650,000 square miles of possible oil bearing land, offers great promise of aiding very materially in maintaining Western Hemisphere reserves, especially when the factor of Canada's limited population of some 13,854,000 people is considered.

A recent symposium of "Future Petroleum Provinces of North America" published by the American Association of Petroleum Geologists in 1951 gives the following impressive geological facts and statistics which further emphasize the great potential importance of Canada to the future of Hemisphere petroleum supply:

(1) Only 125 exploratory wells have penetrated the very productive Rundle (Madison) Limestone of Mississipean Age, giving a density within the assumed area of distribution of this formation of one well to 2400 square miles.

(2) Only 285 exploratory wells have penetrated the Devonian deep enough to test the D3 reef member or in its absence the somewhat deeper "fragmental limestone" zone indicating a density of one well to 2070 square miles.

(3) Only 78 wells have reached the top of the salt bearing section of the Middle Devonian making a density of one well in 7555 square miles.

(4) Only 28 wells have been drilled to the top of the Cambrian basement, representing a density of one in 21,800 square miles.

In addition to the above, the areas of possible future interest as potential petroleum producing regions are noted to be:

(1) Flatland River District in southeast British Columbia within the Rocky Mountains where active oil seepages are present but drilling to date has been unsuccessful.

(2) Fraser River Delta near Vancouver. Drilling has been carried to 5,000 feet so far without success.

(3) Gulf Islands near south east coast of Vancouver Islands where a belt of Cretaceous is present.

(4) Queen Charlotte Island where oil seepages and oil shales occur and a shallow well drilled many years ago is reported to have had oil and gas showings. Tertiary, Cretaceous, and Jurassic beds are reported on Graham Island the most northerly of this group where recently a dry hole was completed at 3500 feet.

With regard to the famous Athabaska Tar Sands of Canada the Symposium declared that more than 99 percent of the deposit is too deeply buried for mining under present conditions and stated further that, "The only workable deposits are the benches and interstream areas in the valleys of the Athabaska River and some of its tributaries where the streams have cut through the overlying beds and into or through the oil sands. The mineable areas are estimated to contain at least a million barrels of oil. Core drilling has revealed 265,000,000 barrels for one square mile and five contiguous sections appear to be almost as good. The feasibility of hot water separation of the oil from the sand has been demonstrated by prolonged runs in two different commercial sized pilot plants, each with a through put capacity of 300 - 500 barrels a day. Results indicate that in large scale operation the cost of the crude would be comparable with the average cost of oil from wells, although probably higher than the cost of crude from flush fields. Whether the development of the sands must wait until the fields of Alberta have passed their flush stage, or can be

integrated with the development and transportation of the oil from such fields is the subject of an intensive study being carried on by the Alberta Government."

Oil consumption in Canada has likewise been growing apace. In 1938 it was 128,000 barrels per day, in 1943, 170,000 barrels per day, and in 1948, about 280,000 barrels. To expand production to meet the soon to be required 400,000 barrels per day will take large amounts of capital. Also, Canada's refinery and pipeline capacity must similarly be greatly increased if overall self sufficiency is to be attained. Much of the capital required will undoubtedly come from the United States (according to J. E. Pogue about 500 million dollars on a fifty fifty basis between United States and Canadian sources will be necessary). It is to be hoped that every success will be attained as regards this capital formation for the exploration and production activities in Western Canada are particularly opportune and significant as regards United States and Western Hemisphere security.

B. Venezuela*

Venezuela's oil production has increased from 120,000 barrels in 1917 to 621,000,000 barrels in 1951. Mexico's loss as a result of the expropriation of foreign oil properties became largely Venezuela's gain and undoubtedly greatly accelerated Venezuela's development. However, at no time has the Venezuelan Government lost sight of the tremendous advantages to be gained by the development of its great oil resources by foreign enterprise. As a result, a largely agrarian type country is being rapidly and impressively transformed. In addition there have been several major iron ore discoveries in Venezuela since World War II. These high quality ore sources are vital to the United States and promise to give further impetus to Venezuelan development. As a result of the abundant production of crude oil and more recent production of iron ore, the Venezuelan economy is becoming increasingly oriented toward the United States. A possibility exists that Venezuela may gain further petroleum tariff concessions from the United States in the not too distant future. The present petroleum tariff is 21 cents a barrel on crude but under the existing agreement about one third of Venezuela's petroleum comes in at 10½ cents. The Caracas Government wants the 10½ cent rate applied to all it's oil, or even better still, to have the United States grant the maximum concession permitted by the general reciprocal trade agreement of 5¼ cents a barrel.

Petroleum production in Venezuela, which country remains second only to the United States as a world producer of petroleum, dates back to 1878. Initial development was slow, however, and it was not until 1914 that the first of Venezuela's important fields was discovered. This was

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*See Appendix II.

the Mene Grande Field on the east side of Lake Maracaibo. In 1922 Los Barrosas #2 well came in with a flow of 100,000 barrels per day and interest in the country further increased. Expropriation of foreign oil properties in Mexico in 1938, as previously mentioned, provided additional impetus to the rapid development of Venezuelan oil.

Today production in Venezuela is at a new high of 1,800,000 barrels per day and almost 100,000 barrels per day over the 1951 average of 1,705,000 barrels, which in turn represented a 200,000 barrels per day increase over the 1950 figure of 1,500,000 barrels. The Maracaibo Basin remains Venezuela's most important producing area and the east side of the basin is practically one continuous oil field. Geologically speaking, Venezuela oil comes from two areas, Eastern and Western. Eastern Production last year was at a rate of about 500,000 barrels per day and Western Production, at about 1,200,000 barrels. In 1950 production for Western Venezuela amounted to 71% of the total compared to 69% during 1949. Of this percentage Bolivar Coastal Fields contributed 50% in 1950 compared with 47% in 1949 and the cretaceous limestone fields of west of Lake Maracaibo 16%, the same as in 1949. Average daily oil production per well for the entire country during 1950 was 238 barrels compared with 225 barrels in 1949. Estimated total potential production for Venezuela at the close of 1950 was 1,645,000 barrels per day compared to 1,561,000 barrels per day at beginning of the year.

To discuss in detail the prospects of Venezuela's basins and producing areas would take a great deal of space and involve the quoting of expert opinion. It is considered sufficient for this study to state that those who have studied Venezuela believe that a crude production of 2,000,000 barrels per day will be attained. This would be substantially above the

present output of 1,800,000 barrels per day.

To date Venezuela, which retains the position of being the world's largest exporter of petroleum, has produced over six billion barrels of oil. Reserves are estimated at from nine to ten billion. One field, Laguinillas, has produced over two billion barrels. As of 1949 27 principal Venezuelan fields had produced a total of 4,900,000,000 barrels from 350,947 acres for a recovery rate of 13,962 barrels per acre. Tia Juana and Cabimas Fields at the end of 1949 each had total production of over 600 million barrels and Oficina passed the 325 million barrel mark the same year. As of 1949 424,453 acres were considered productive in all fields with a total of 18,054,000 acres or approximately 8 percent of Venezuela's total acreage under concessions which were then held by 24 companies. About 2.35 percent of the total concession area was productive. Acreage held in concessions has declined. As of 31 December 1951 some 15,543,177 acres were held. This is a decrease of more than 13 percent from 1949. As the above statistics show several Venezuelan oil fields have been prolific producers. Also, although more is known about the geology of Venezuela than of any other Latin American country as a result of the 12,500 wells which have been drilled, there are large areas in Venezuela which have not yet been tested by drilling. It, therefore, seems a reasonable assumption that additional major fields remain to be discovered.

In the absence of 1951 figures it should be noted that while production for 1950 was 13 percent greater than in 1949 there were nine fewer wells completed. Of the 673 wells completed in 1950, 593 were oil producers (88%), 5 were gas wells, and 75 (11%) were dry. Exploitation wells totaled 455 or eight more than in 1949, while exploratory completions were down 17 wells to 218. Seventy two percent of the exploratory

completions in 1950 were oil producers. Moreover, during 1950 only 73 rigs were operating on new drilling as compared to 100 in 1945. Party months (the usual indicators of exploration effort) for 1950 and 1949 were as follows:

	1950*	1949*
Seismic	149	231.6
Gravity	34.9	92.9
Surf. Geol.	182.3	260.4
Struct. drilling	30.5	29.2
Telluric current	12.0	--

No new oil concessions are being granted by the Government at the present time. Most of the concessions now in force have been tested by at least one surface method.

The Venezuelan Petroleum Law of 1943 is now in force. This law raised royalty payments to the Government to 16 and 2/3 percent and provided that the operating companies could convert all concessions obtained under prior laws into new concessions carrying a term of 40 years. Virtually all companies have converted their concessions under the new law.

The Petroleum Law also authorized the Government to take measures for the encouragement of refining in the country. In accordance with this policy and except in certain cases where an alternative refining obligation might be negotiated, an undertaking to refine within Venezuela the equivalent of one-tenth of the production from all new concessions granted after passage in 1943 of the law must be assumed. However, this requirement was not applied to converted concessions. For new concessions it was also specified that the remaining nine-tenths production could not be refined in

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* Data by D. D. Porterfield in article on Venezuelan Production, appearing in AIME Proceedings for 1950.

the Caribbean area outside of Venezuela. In presenting the law to the Congress the Venezuelan Government claimed that their calculations showed that the sum of the royalty payment and taxes would give the country a participation equal to the net profits of the industry. However, according to calculations of Mr. Joseph E. Pogue of the Chase National Bank of New York, "In each year since 1943 the Government has received a greater share of the earnings than industry". His figures show that for the period 1943 through 1946 the total income to the Government amounted to some 1,131 million dollars versus 971 million dollars of net income to the oil industry.

Discussion of Venezuela's future capabilities can best be summed up by again quoting Mr. Pogue:

> "It is the policy of Venezuela itself, however, which will have the most to say about the future of Venezuelan oil and its bearing upon the economy. This policy has been such that a large and vigorous oil production has unfolded, bringing the Nation to a commanding position in the world of oil. It should be remembered, however, that this development took place under the impact of extraordinary, and partly transient, economic forces. Venezuela has benefited from the enlarged demands of the war and its aftermath and from the repressive policies followed by several countries which thereby retired from the field of competition in promoting the search for and development of oil."[1]

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[1] "Oil in Venezuela, published by Chase National Bank, p. 45, June 1949.

C. Mexico*

Mexico's oil history has been a very disturbed one. The initial climax to what looked like a promising development in earlier years occurred in 1938 when the government took over the foreign oil holdings by expropriation. Total Mexican production to date amounts to about 2.5 billion barrels and as of 1 January 1952 her reserves were estimated at 1.4 billion barrels. The outlook for Mexico has been summed up by the Petroleum Administration for Defense in a recent release which credits Mexico with having a current crude production of 227,000 barrels per day. The Report tersely states "more production only from new discoveries".

Petroleos Mexicanos, more familiarly known as Pemex, is the Government Oil Company which took over operations after expropriation. Pemex continued, although rather slowly, the development of oil fields and enlarged the limits of several areas notably Poza Rica, a field which was discovered in 1930. Currently this field produces approximately 144,000 barrels per day or more than half of Mexico's current production. Pemex's Chief Geologist stated in 1949 that, "reserves yet to be discovered surely represent at least more than double all the oil discovered to date within the boundaries of this country."[1] One factor which lends strength to this statement is that Mexico's oil production so far has come from a relatively small area of oil fields.

Mexico's more or less gradual increase in crude production took quite a jump in 1950. Figures rose from 58,313,993 barrels for 1948 to 60,902,992 barrels for 1949 and reached 72,426,154 barrels in 1950 plus a production of 1,459,010 barrels of natural gasoline for a grand total of

* See Appendix III

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[1] Quoted by Committee of Interstate and Foreign Commerce in their Progress Report. "Fuel Investigation - Mexican Petroleum", U. S. Government Printing Office, Washington, D. C., 1949.

73,885,164 barrels. During 1950 there were 67 rigs operating and 17 wildcats plus 202 extensions were drilled. This compares with a total of 102 wells drilled in 1948. Of the 1950 wells 133 wells were productive for a 61 percent overall success ratio. Pemex reported five discoveries in 1951 of which Jose Colomo and Rabon Grande may prove to be the most important fields. The government reported also that some 267 wells were drilled during the year.

Pemex currently reports that it has outlined some 120 structures that are ready for testing, many of them in the Isthmus area, where Rabon Grande, Jose Colomo, Fortuna Nacional, and the Concepcion Fields are located. There were reported to be 113 rigs currently in use on wildcat and development drilling compared with the 67 which were operating in 1950. Also there are 44 geophysical parties engaged in active exploratory operations.

Presumably, if Pemex can realize its program there should be a continued steady increase in production. If this results, Mexico will continue to supply her own needs and also to increase the amount of oil exported. However, it would seem also as the Petroleum Administration for Defense has noted that any large increases in production will have to come from the discovery of new areas, and not from the exploitation of known reserves. It should be emphasized, moreover, that since the expropriation year of 1938 no major oil field has been discovered. Finally, if United States Oil Companies which have the "know how" were permitted to go into Mexico and aid in the development of her undiscovered petroleum resources on reasonably fair terms it seems quite possible, to this writer, that Mexico's position in the world oil picture could be vastly improved.

D. Colombia

Colombia obtained an early start in the oil business, with oil seepages having been noted as early as 1866 at Tubara near Cartagena. In 1905 the Colombian government authorized its first oil concessions, those at De Mares and Barco. However, to date the results have been rather disappointing and the country as yet has not lived up to its early promise.

Although the first drilling which was on the De Mares concession in 1916 found the Infantas Field, it was not until 10 years later when the Andean Pipeline was completed that any oil was exported. Oil seepages at Petrolea within the Barco concession were likewise worked quite early and the Rio de Oro Field was established in the early twenties, but it was not until 1939 that the concession began to export oil.

One difficulty has been the lack of real exploration. As of 1950 some 198 wildcat wells had been drilled in Colombia. These widely scattered wells have only scratched the surface of petroleum possibilities besides yielding only a minimum amount of the necessary geological information.

There has been some recent improvement, however, and Colombia's present production amounts to 105,000 barrels per day. The De Mares concession reverted to the Nation in 1951 when the terms of the agreement expired. However, International Petroleum Company Ltd., a subsidiary of Standard Oil of New Jersey,currently holds concession contracts and applications for contracts on other areas in Colombia, and these areas are now being extensively explored. In one of these areas, 75 miles down the Magdalene River from De Mares in what is known as the Middle Magdalene Area, a wildcat

well, Totumal No. 1, was brought in during November 1951. The well flowed at a rate of about 1000 barrels daily. New fields have also been discovered on the Barco Concession where the North and South Sardinata have tested production and a deeper horizon at Rio de Oro has yielded oil.

Colombia's oil still appears more a question of the future than of the past. Colombia, in the decade of the 1920's, was considered by many to be geologically a better prospect than Venezuela. There have been some 521,000,000 barrels of oil produced from the De Mares Concession and approximately 70,000,000 barrels from the Barco Concession. It would seem logical, therefore, to assume that there is more oil waiting to be discovered in a country where such large amounts have already been found.

E. Trinidad

The island of Trinidad has had a very stable petroleum production over the last five years. Production has remained between 55,000 and 56,000 barrels per day during this period and the annual footage drilled has ranged between 630,000 and 660,000 feet.[1] The search for new horizons has been a continuous one but stratigraphic conditions on the island are extremely complex. A total of fourteen deep tests to find Cretaceous production resulted in only one producer. Currently, development continues in the Miocene in order to maintain production and accordingly forecasts at the present time as to future production would seem to have little basis. Trinidad is at present a net importer of oil with net imports averaging 25,000 barrels per day during 1950 and at a slightly higher rate in 1951.

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[1] Data quoted IPAA, Columbus, Ohio, April 28, 1952, by W. H. Farrand, Acting Assistant Deputy Administrator, Petroleum Administration for Defense.

V

AREAS OF LESSER IMPORTANCE

Mr. A. D. Stewart, Chief Economist for Socony Vacuum Oil Company, predicts that the total crude supply for South American countries (less Caribbean) will amount to some 123,000 barrels/daily for 1952; 127,000 barrels for 1953; 131,000 barrels for 1954; and 134,000 barrels for 1955. These figures show both the relatively small total production for these areas and the relatively small annual percentage increase which is anticipated. Producing countries with their current crude production in barrels per day are: Peru (43,000), Argentina (68,000), Brazil (2,000), Ecuador (7,200), Bolivia (1,500), and Chile (1,500). Of the South American Countries (other than Caribbean) Argentina, Brazil and Uruguay consume more crude than they produce, and Ecuador, Bolivia, Chile, and Peru produce more than they consume.

Peru's peak year was 1936, when 17,593,000 barrels were produced, for a daily average of 48,068 barrels. Production declined after that but during the last five years has been making a steady, though small, recovery. Chief producing areas are in northwest Peru near Talara, and the Aguas Calientes Field on the eastern side of the Andes.

In Argentina private companies are permitted to work fields they already own but are prohibited from obtaining new concessions. Only the Government Oil Corporation can extend its explorations. As a result, in 1947, Government Oil fields produced about 41,600 barrels per day and private company fields about 18,000 barrels per day. By 1951 the Government Oil Corporation had gone to 53,000 barrels per day but private production had declined to 14,700 barrels per day. The most recent development has been

the bringing in of a new exploratory well in the Campo Duran Field adjoining the Bolivian border. Drilled to 10,800 feet and producing at the rate of 1,500 barrels per day this is the deepest and most productive well in Argentina. In spite of this single major completion, the prospects for increased production seem relatively slight. Recently Argentina has been rumored to be attempting to arrange a barter arrangement for Iranian Oil. However, Argentina possesses neither the surplus food nor the surplus tankers to make such an arrangement likely. Net imports in July 1951 were at the rate of 45,000 barrels per day.

Brazil began development of her petroleum resources under government monopoly in 1938 and a year later brought in her first field, the Lobato-Joanes. Seven other fields have since been discovered. All eight fields are located in the State of Bahia and have a total of approximately 137 producing wells. Production at present is more or less stationary and is limited by the capacity of the Mataripe refinery which is being presently expanded from a 2,500 to a 5,000 barrels per day capacity. Brazil supplies less than 5% of her daily requirement for 100,000 barrels and reliance on imports seems likely to continue, although Brazil could probably become a much more important oil producer. Brazil has sedimentary basins favorable to accumulations of petroleum that in total are at least the size of Texas. The government, however, being unable to carry on large scale exploration on its own, appears unwilling to let foreign enterprise take over.

Ecuador has had a total production to date of about 45 million barrels. Production has come principally from the Ancon-Tigre-Cautivo fields which were discovered in the early 1920's. No large productive areas have been located since, despite a continuing search, and these fields continue

to turn out the bulk of Ecuador's limited annual production. This production reached 2.3 million barrels in 1947 and is currently running at an annual 2.6 million barrels. Future prospects do not appear favorable.

Bolivia's petroleum history began in 1921 when Standard Oil of New Jersey obtained a concession in the southern part of the country. Bermejo was discovered in 1922 and the Sanadita Field in 1926, the latter having a cumulative production to 1 July 1950 of 1,735,000 barrels. In 1927 Camiri Field, the largest of the Bolivian fields, was discovered. With about 16 wells this field had a cumulative production to 1 July 1950 of 2,600,000 barrels. On 13 March 1937 Bolivia became the first of the South American countries to expropriate oil concessions and since that time little has been accomplished. The most significant discovery of the Government Oil Corporation was the Guayruy Field, which it found in 1947. By 1947 production for the nation as a whole was only 1,500 barrels per day. Geologically Bolivia appears to be a favorable area. However, despite a new oil law passed by the Bolivian Congress in 1950 there apparently have been no great number of applicants for oil concessions and no announcements have been made to date as to any concessions granted. The recent Bolivian revolution would seem to make even more remote the participation of foreign capital in the development of Bolivia's oil resources.

After making the petroleum industry a government monopoly by a law passed in 1926, Chile temporarily reversed itself and several companies applied for concessions. In 1928, however, the Congress again reversed itself and withdrew its permission for the granting of concessions. This law has remained in effect ever since. Only one section of Chile has ever been considered geologically favorable, the extreme southern end, at the Strait of Magellan, known as the Santa Cruz Basin. Much of the Brunswick Peninsula

and Spring Hill areas here have been mapped and the Spring Hill discovery well was completed in 1945. Of the first 20 wells drilled after the discovery well, 11 were oil producers, and 4 were gas wells. Production, however, has not been great and the present production amounts to 1,500 barrels per day, all of which is shipped to Uruguay since there are no Chilean refineries.

VI

POSSIBLE FUTURE DEVELOPMENTS WHICH COULD ADVERSELY AFFECT WESTERN HEMISPHERE PRODUCTION

In the introduction to this thesis it is stated that the petroleum picture in the Western Hemisphere cannot be entirely disassociated from the world picture. Development of the thesis has proceeded, however, on the assumption that military considerations, public opinion, and economic incentive will govern in the future to an extent which will insure the continued and uninterrupted development of additional reserves in the Western Hemisphere as our petroleum requirements continue to rise.

In the world picture today there is one major aspect which though not yet of unfavorable significance may become so. This is the question of cartel or "As-is Agreements" between the Big Five international oil companies and the possible effects therefrom on Western Hemisphere production if world oil pricing plans are undertaken by these companies. The Big Five Companies are Anglo-Iranian; Shell; Standard Oil Company (New Jersey); Caltex (which is a subsidiary of Standard of California and the Texas Company); and Gulf. Without detailing the worldwide operations of these companies, the important facts to an understanding of the overall picture are: (1) the tremendous oil reserves of the Middle East where extremely low producing costs prevail, (2) the very considerable investment of these companies in the Middle East, (3) the mounting political tension of the entire Middle East resulting from its closeness to the U.S.S.R., and (4) the greatly increased costs of finding new oil in the United States.

For these reasons alone the possibility must be assumed to exist that when a sufficient number of the new tankers now being built are available, the United States companies in the Big Five may become increasingly reluctant to prosecute expensive exploration and development programs within the Western Hemisphere, at least on a scale proportionate to their share of the United States and Western Hemisphere market (except possibly in Venezuela and Canada where subsidiary companies already have major concessions). Such a policy would tend in itself to promote (1) higher oil prices in the United States, (2) increased United States imports of Middle East Oil and (3) lead to a decline in Western Hemisphere productive capacity.

The possibility likewise exists that the United States public may be "sold" the idea of a national or Western Hemisphere conservation program, which would substitute importation of Middle East Oil for a significant portion of United States or Western Hemisphere production. Such a program, in the opinion of this writer, would tend to decrease rather than increase United States national security in the short term (tankers are especially vulnerable to both submarine and air attack) and in the long term could have even more adverse and serious effects. It is possible in this thesis only to note the unfavorable military aspects of too great a dependence on Middle East Oil with consequent restriction on the development of Western Hemisphere sources. The following passage from "Resources for Freedom", Vol. 111, 1952, A Report to the President of the United States by the President's Materials Policy Commission, is considered/to very concisely sum up this viewpoint:

> "The United States cannot take undue comfort from the prospect that the Western Hemisphere will perhaps remain self sufficient in oil for a long time. Its friends and allies in the Eastern Hemisphere will become increasingly dependent on the Middle East, but if supplies from that area should be substantially reduced in time of war those allies would then have to be supplied from the remaining sources, largely in this hemisphere. The pattern of wartime supply

> and consumption for which preparation must be made is therefore a single comprehensive pattern for the entire world."

The above discussion has been intended to point up the two possible developments which admittedly could very adversely influence future petroleum supply in the Western Hemisphere. It must be presumed, however, until proved otherwise, that sound judgement will prevail in these matters and that a close cooperation between industry and government will continue to be achieved. Clearly the security problem in oil will become an ever more difficult one. Correspondingly, the problems faced by the Petroleum Administration for Defense in assuring an adequate supply of oil must inevitably also become increasingly complex. Wise leadership and the same spirit of cooperation and patriotism which made possible such notable achievements in meeting petroleum problems of World War II will be required if these likely impending difficulties, with the dilemma which they will pose, are to be surmounted, as of course they must be.

VII

CONCLUSIONS

1. The estimate of future petroleum demand in the Western Hemisphere is essentially a short range evaluation which must be based on current trends and on economic factors, not the least of which is the price of oil.

2. An estimate of the future production of petroleum in the Western Hemisphere is difficult and even though based on accepted principles and techniques remains largely subjective (this is so because any evaluation of the past and its projection into the future will be influenced in varying degree by the attitude and outlook of the person doing the forecasting).

3. The present planning of the Petroleum Administration for Defense is by far the most comprehensive type yet placed in effect for defense mobilization. By furthering the development of additional petroleum supplies in those areas of the Western Hemisphere where economic incentive and the geological aspects appear most promising and where the political uncertainties are at a minimum it is performing a highly important function. The means of accomplishing this objective, moreover, are through the exercise of primary responsibility for allocation of scarce steel oil country supplies to foreign areas other than Canada and through close coordination with industry and with other branches of the government.

4. Assuming no major shortages of steel to meet the forecast requirements of the Petroleum Administration for Defense, present statistics and trends would seem to indicate an availability of petroleum within the

Western Hemisphere sufficient to meet presently predicted Hemisphere requirements for the next few years. This conclusion assumes the absence of an all out war.

5. It is obviously impossible to assess the capabilitier of Western Hemisphere petroleum supply to meet the large scale requirements of an all out war. Such a determination would have to be based on highly classified information, including national and military objectives and on time schedules. It seems axiomatic, however, that the greater the available surplus of petroleum supply within the Western Hemisphere, the stronger the position of the United States and of the Western World becomes.

APPENDIX I

STATISTICS FOR CANADA*

Annual Crude Production
(thousands of barrels)

1930 - 1522
31 - 1543
32 - 1044
33 - 1145
34 - 1411
35 - 1447
36 - 1500
37 - 2944
38 - 6966
39 - 7838
40 - 8591
41 - 10134
42 - 10365
43 - 10052
44 - 10009
45 - 8483
46 - 7586
47 - 7692
48 - 12098
49 - 21010
50 - 28715 (By "World Oil")
51 - 47450 do
52 - 91250 (Estimate based on PAD figure of current production)

Annual Imports
(in thousands of barrels)

1950 - 81,791
1951 - 99,515

Refinery Capacity
As of 1 January 1950
(barrels per day)

(33 refineries)

Crude - 328,800
Cracking- 166,800

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* Except as otherwise indicated, statistics are from "Petroleum Facts and Figures" Ninth Edition, 1950, published by American Petroleum Institute.

APPENDIX I (Continued)

Production by Province and by Fields

(for period January 1 - June 30)
(According Dominion Statistics Bureau, Ottawa)

	1950	1949
New Brunswick	8,231	9,807
Ontario	123,866	112,839
Saskatchewan	485,943	410,612
Alberta		
Leduc	4,893,137	4,714,287
Lloydminster	397,980	366,740
Redwater	3,934,730	1,535,842
Turner Valley		
Crude	1,723,748	1,956,424
Nat. Gasoline	219,052	238,773
Brooks	6,566	7,868
Conrad	53,040	83,777
Dina	9,350	7,857
Excelsior	60,598	-
Golden Spike	135,166	32,187
Joseph Lake	45,275	3,890
Normandville	13,272	-
Princess	54,770	59,095
Stettler	75,680	1,434
Taber	71,973	86,710
Vermillion	26,742	49,542
Wainwright	7,152	8,305
Whitemud	27,632	3,466
Other Areas	25,007	13,783
Total for Alberta	11,782,870	9,169,980
N. W. Territories	97,345	109,357
Total Canada	12,498,255	9,812,595

APPENDIX II

STATISTICS FOR VENEZUELA *

Annual Crude Production
(thousands of barrels)

1930 - 136,669
31 - 116,613
32 - 116,541
33 - 117,720
34 - 136,103
35 - 148,254
36 - 154,794
37 - 186,230
38 - 188,174
39 - 206,470
40 - 185,570
41 - 228,430
42 - 147,675
43 - 177,631
44 - 257,046
45 - 323,156
46 - 388,486
47 - 434,905
48 - 490,015
49 - 482,316
50 - 546,782 (by World Oil)
51 - 621,230 do
52 - 657,000 (Estimate based on PAD figure of current production)

Indicated Annual Consumption
(thousands of barrels)
(derived from World Oil statistics)

1950 - 93,886

Refinery Capacity
(barrels per day)

(15 refineries)

Crude - 253,670
Cracking- 32,000

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* Except as otherwise indicated, statistics are from "Petroleum Facts and Figures", Ninth Edition, 1950, published by American Petroleum Institute.

APPENDIX II (Continued)

Foreign Operators	Production (barrels)	
	1950	Cumulative
Creole	232,719,803	2,524,783,246
Shell	181,679,146	1,897,207,230
Mene Grande	88,804,526	920,600,471
Socony Vacuum	13,471,165	61,366,670
Venezuela Atlantic Refin.	7,644,394	13,125,873
SAP Los Mercedes	6,827,498	15,151,162
Sinclair	4,598,160	59,601,332
Richmond	4,563,079	6,167,651
Texas Petroleum Company	3,300,899	13,585,837
Phillips	2,734,407	5,314,640
British Controlled		
Oil Ltd.	363,167	31,047,265
Guasan Oil Company	23,595	75,079
Others		3,513,579
	546,729,839	5,551,540,035

According to a recent report of The Third World Petroleum Congress, 949% of Caribbean Oil (which includes of course Trinidad) is owned by the Big Five International Companies, namely, Anglo-Iranian, Shell, Standard Oil of New Jersey, Cal - Tex (Standard of California and Texaco), and Gulf.

APPENDIX III

STATISTICS FOR MEXICO*

Annual Crude Production (thousands of barrels)				Net Annual Exports (thousands of barrels)			
1930	-	39,530		1930	-	24,091	
31	-	33,039		31	-	20,162	
32	-	32,805		32	-	20,586	
33	-	34,001		33	-	18,264	
34	-	38,172		34	-	21,206	
35	-	40,241		35	-	19,089	
36	-	41,028		36	-	21,712	
37	-	46,907		37	-	20,717	
38	-	38,506		38	-	12,215	
39	-	42,898		39	-	16,615	
40	-	44,036		40	-	17,850	
41	-	42,196		41	-	13,664	
42	-	34,815		42	-	4,693	
43	-	35,163		43	-	3,876	
44	-	38,203		44	-	2,938	
45	-	43,547		45	-	5,940	
46	-	49,235		46	-	6,025	
47	-	56,284		47	-	10,185	
48	-	58,508		48	-		
49	-	60,910		49	-		
50	-	72,443	(by World Oil)	50	-	16,110	(by World Oil)
51	-	76,532	(by World Oil)	51	-	11,775	(by World Oil)
52	-	72,855	(estimate based on PAD figure of current production)				

* Except as otherwise indicated, statistics are from "Petroleum Facts and Figures", Ninth Edition, 1950, published by American Petroleum Institute.

APPENDIX III (Continued)

Annual Petroleum Production from Major Productive Fields*
(thousands of barrels)

	1945	1946	1947	1948
Panuco	5,294	8,652	10,062	10,000
Golden Lane	10,062	8,523	7,840	7,600
Poza Rica	22,949	26,312	31,951	34,100
Isthmus	5,242	5,847	6,431	5,800
Total	43,547	49,235	56,284	57,500

Mexican Refineries & Capacity (1948)*
(barrels per day)

Tampico	49,000
do	18,400
do	9,600
Poza Rica	6,000
Isthmus Tehuantepec	26,000
Mexico City	45,000
Juarez	500
Total	144,500

Presently Listed Refinery Capacity as of 1 January 1950

Crude	160,350 barrels per day
Cracking	25,900 barrels per day

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* Data from "Fuel Investigation-Mexican Petroleum", Progress Report of Committee of Interstate & Foreign Commerce, Pursuant H. Res. 595, Eightieth Congress, U. S. Government Printing Office, Washington, D. C., 1949.

APPENDIX IV

STATISTICS FOR COLOMBIA*

Annual Crude Production
(thousands of barrels)

1930	-	20,346	
31	-	18,237	
32	-	16,414	
33	-	13,158	
34	-	17,341	
35	-	17,598	
36	-	18,756	
37	-	20,599	
38	-	21,582	
39	-	23,857	
40	-	25,593	
41	-	24,553	
42	-	10,467	
43	-	13,261	
44	-	22,291	
45	-	22,449	
46	-	22,118	
47	-	24,794	
48	-	23,792	
49	-	29,722	
50	-	34,091	(by "World Oil")
51	-	38,325	(by "World Oil")
52	-	38,325	(Estimate based on PAD figure for current production)

Annual Exports
(according to "World Oil")
(thousands of barrels)

1950	-	24,568
1951	-	26,065

Refinery Capacity
(as of 1 January 1950)

Crude - 23,700 barrels per day
Cracking - None

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* Except as otherwise indicated, statistics are from "Petroleum Facts and Figures", Ninth Edition, 1950, published by American Petroleum Institute.

APPENDIX V

STATISTICAL SUMMARY INCLUDING RATIO OF PRODUCTION TO CONSUMPTION (ACTUAL AND PROJECTED) FOR WESTERN HEMISPHERE

A. RECENT STATISTICS

*Crude Oil Production (Barrels per Day)

	1946	1951	% increase
Canada	20,000	131,000	555.0
United States	4,751,000	6,149,000	29.4
Venezuela	1,064,000	1,705,000	60.3
Other Latin America	350,000	496,000	41.7
Total	6,185,000	8,481,000	37.1

*Consumption

	1946	1951	% increase
Canada & Alaska	230,000	417,000	81.3
United States	4,912,000	7,043,000	43.4
All Latin America	590,000	952,000	61.4
Total	5,732,000	8,412,000	46.7

Ratio of Production to Consumption

1946	1951
1.08	1.01

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* Data from Standard Oil Company of New Jersey 1951 Report to Stockholders.

APPENDIX V (Continued)

B. OUTLOOK FOR 1952

**Petroleum Demand (Barrels per Day)

United States	7,290,000
Other North American	745,000
Caribbean	375,000
Other South American	384,000
Total Western Hemisphere	8,794,000

***Current Crude Production (Barrels per Day)

Canada	225,000 to 300,000	
Venezuela	1,800,000	
Mexico	227,000	
Colombia	105,000	
Peru	43,000	
Argentina	68,000	
Trinidad	56,000	
Brazil	2,000	
Cuba	300	
Ecuador	7,200	
Bolivia	1,500	
Chile	1,500	
United States production according to "World Oil", 15 February 1952 issue		6,336,100
Total for Western Hemisphere		8,947,600

Ratio of Production to Consumption for 1952 computed from the above data equals 1.015.

** According to A.D. Stewart, Economist for Socony Vacuum Oil Company[1]
*** According to W. H. Farrand, Official, Petroleum Administration for Defense (PAD Release, 23 June 1952).

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[1] From table contained in article "World Demand to Continue Upward Trend", Oil and Gas Journal, issue of December 20, 1951

APPENDIX V (Continued)

STATISTICAL SUMMARY INCLUDING RATIO OF PRODUCTION TO CONSUMPTION (ACTUAL AND PROJECTED) FOR WESTERN HEMISPHERE

C. PETROLEUM DEMAND OUTLOOK FOR IMMEDIATE FUTURE ACCORDING TO A. D. STEWART[1]

(thousands of barrels daily
with percentage increase over previous years indicated)

	1952	%	1953	%	1954	%	1955	%
United States	7290	5	7611	4	7775	2	7937	2
Other North America	745	6	788	6	831	5	875	5
Caribbean	375	19	388	3	401	3	414	3
Other South America	384	7	423	10	457	8	485	6
Total Western Hemisphere Excluding U.S.	1504	9	1599	6	1689	6	1774	5
Including U.S.	8794	5	9210	5	9464	3	9711	3

D. SUMMARY

Indicated Western Hemisphere crude production for 1952 is running at a 5.5% annual increase (8,947,600 barrels per day versus 8,481,000 barrels per day for 1951). Continuation of this current annual rate of increase would result in a projected crude productivity of 10,482,631 barrels per day for 1955. In combination with the above projected demand figures this would give annual production to consumption ratios as follows:

1953, 1.025; 1954, 1.05; 1955, 1.055.

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[1] "World Demand to Continue Upward Trend", Oil and Gas Journal, issue of December 20, 1951.

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